

## PASSIVE SMART TEXTILE

P. LIZÁK

*KPD FPT TnU AD; Ružomberok, Slovakia, lizak@fpt.tnuni.sk*

**ABSTRACT:** We can find very similar discussion on these terms in the book called „smart structures“. It states, that the material itself cannot be intelligent (smart). It only has specific characteristics which can be used for the construction of smart structures. Structures are considered to be smart when they are able to independently evaluate the state of the surroundings and to respond properly to it. We cannot talk about cognitive systems, because they are not selected from various possibilities of reaction. Textile structures are considered to be smart when they are sensitive to external stimulus (various kinds of radiance, pH, mechanical, magnetic, electrical field) and to react by a feedback to the changes of this stimulus (usually with the change of shape).

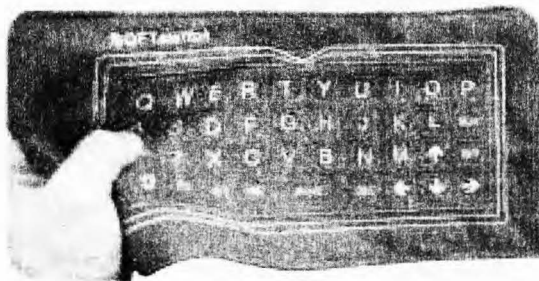
**KEY WORDS:** smart textile fabrics, fashion electronics, smart

### 1. INTRODUCTION

These textile fabrics are in many cases used as fashion textile dedicated to achieve the top comfort (protecting from thermal deviation by regulating conditions of air and water vapour ventilation), also as accelerators of communication or for use of common electric devices (cell phones, location and the human state indicators, computers). They are also very important for military purposes, first of all for protection from extreme climatic conditions, and indication or protection from war gas, bacteria, virus.

### 2. PASSIVE SMART TEXTILE FABRICS

They are sensitive to external stimulus because of sensitive elements and indicators of surrounding state e.g. optic fibres, which not only transfer the light signal, but which are also sensitive to deformation, concentration of chemicals, pressure, accelerating, electric current and magnetic field, etc.



**Fig. 1:** Woven keyboard SOFTSWITCH



**Fig. 2:** Woven keyboard of musical instrument SOFTSWITCH

Not only optic fibres are used for realisation of location scanner and various switches on the base of textile structures, but also conductive fibres find their use here. Location is usually shown on the parts where textile fabric is pressed (Fig. 1). They are suitable also as the substitution for keyboard of musical instruments (Fig. 2).

Textile keyboard is developed in MIT and embroidered from Kevlar and steel wires. It uses the sensitive elements of electric charge capacity for differentiation of touch point (Fig. 3). It is possible to register every embroidered number by pressing.

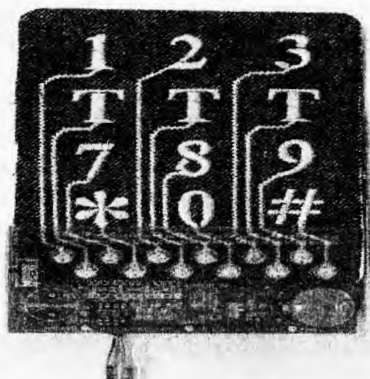


Fig. 3: Embroidered keyboard MIT

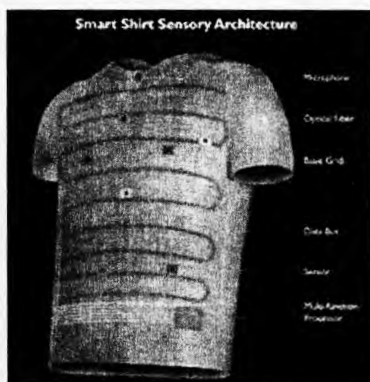


Fig. 4: T-shirt with various kinds of scanner

## 2.1 Fashion electronics

Textile fabric is a holder and a part of electrical devices and this enables her connection with external systems of artificial intelligence. In many cases are these textile fabrics used as fashion textile that provides top comfort (protecting from thermal deviations, stimulation of conditions of air and vapour ventilation). They also make communication or they are used for common electronic devices (cell phones, location indicators and human state, computers) easier. They are also important for military purposes, mainly for protection from extreme climatic conditions, acceleration of identification (camouflage) and indication, or for protection from war gas, bacteria and viruses. Textile fabrics are in the military also used for getting the information about the condition of soldiers with injuries of bullets or bomb fragments, mainly about their extension, i.e. depth of penetrance in body and about life function of injured soldier. These textile fabrics must be at the same time permeant, light, up to standard of comfort when wearing and using, including service and cleaning [2].

The basic information about the state of human being is obtained by sensitive elements of temperature, heart-beat and speed of breathing. These sensitive elements are supplemented with microphone that enables transmission of information by voice. As a result there is a special t-shirt displayed on Fig. 4. It displays arrangements of sensitive elements for heart-beat, breathing, temperature, and voice output. This information is collected in the small electronic device, which is also part of the t-shirt.

That is why woven structure was selected for fulfilling these conditions. Plastic optic fibre was integrated into the structure of woven t-shirt in order to detect the depth of bullet penetrance or fragments, polypropylene fibre was used because of decrease of specific weight, cooper fibre covered with polypropylene and polyamid fibres with inorganic elements was used for electric conductive connection, polyurethane elastomer (Spandex) was used for assurance of mechanical comfort and snugness. At the end Nega-stat for assurance of diversion of electrostatic cartridge was used.

Similar project was solved in Finland for overall design of snow scooter drivers, which have these functions - [3]:

- Protect from the extreme cold and humidity
- Provide information about the driver's condition
- Provide information about location and orientation (via global position system GPS)
- Enable to enter information through textile display.

One of the problems, which are connected to the use of textile fabrics for so called „fashion electronics“ is to provide the suitable power supply (Fig. 5).



Fig. 5: Examples of fashion electronics

## 2.2 Trading estate

These materials serve as barriers for mechanic, electric, magnetic fields and radiation of different lengths (from ultraviolet to infrared) or materials functioning as intelligent filters and separators (sea water desalination) or special sources of energy. They can be used in the field of medicine for intelligent drug dosage (dependent on the state of patient) and diagnosis of human organism deviation.

Classical solution is to place electrically charged batteries into the clothing. These batteries restrain some of the functions of the clothing and in addition they demands charging. It is also possible to use other sources of energy, which can be found in the surroundings (e.g. solar cells) or energy which originates by generation of electric energy when the person wearing clothing moves (Fig. 6). In order to achieve the generation of electric current, we can also use photovoltaic fibres – three different layers of amortal silicon placed among conductive electrodes. Current generated in this way can be used as a source for MP3 players, cell phones and mini computers.

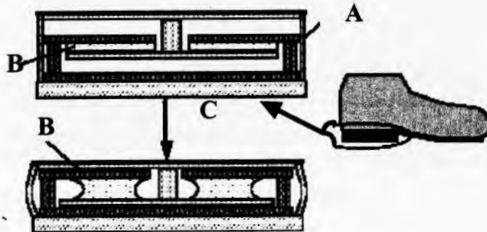


Fig. 6: Electric energy generation while walking  
(A-elastic material, B-electro-active polymer, C-half sole)

### 3. CONCLUSION

Smart textile fabrics are nowadays used as [4]:

- carriers of moving multimedial technologies
- resources of wireless communication
- mobile computers

Among the basic fields of their future use are:

Active dosing system – In clothing sector it enables production of textile fabrics releasing various substances according to requirements from cosmetic substances and pharmaceuticals through vitaminic supplements to protecting substances against insects, bacterias and so on. Intelligent filters, separators and sifters mainly have non-clothing applications.

Monitoring – They could be used not only for the monitoring of human conditions, but also of monitoring of environment. These will use not only clothing, but also technical textile fabrics.

Smart sensitive elements – besides the usual sensitive elements, also a sensitive element of smell, gas, bacteria in the air or in the water is going to be developed. Sensitive elements of the movement and mechanical activity will constitute the part of control system of mainly sick people or sportsmen.

Information technologies – Textile fabrics will, besides electronic functions (substitution of keyboard, touch points, boards of printed circuit, displays and carrier of building electronics), serve for data saving, saving of electrical energy (electrical batteries) and as carriers of micromechanical systems (able to clean it from dust, to repair etc.).

Adaptive materials – they will change the structure, shade, palpation depending on surrounding conditions and human state.

It is visible that many of the mentioned ways of use and functions are at least partly realizable. In order to adopt it in practical use, we will have to solve the problems connected to ergonomics, comfort, durability, maintenance, production, testing and final liquidation.

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